

## COFDM Field Testing Status

### *Summary of Field Testing Status*

Early field testing of COFDM prototype hardware by various European investigators has played and will continue to play a significant role in the development and evaluation of COFDM transmission. Unlike in the United States, Europe did not confine its field testing activities to the verification of the ATV prototype hardware in the field and the validation of the laboratory test results, but rather to assist them in the development and refinement of the COFDM system parameters and the ultimate selection of a COFDM system.

All three systems visited by the Task Force conducted field measurement trials or demonstrations with either their current or an earlier version of their prototype equipment. All three proponents plan to conduct additional and more comprehensive field tests in the 1994-1995 time frame. Moreover, the Task Force was informed that other members of the European Project on Digital Video Broadcasting (ER-DVB) have conducted or plan to conduct additional field testing during the same time period.

Although the level and extent of field investigations varied among the various system proponents we visited, the Task Force is of the opinion that the amount of field test data on digital transmission -- especially relating to multipath -- collected to date in Europe is far greater than what is known to be available in the United States. The European data could be useful in gaining a better understanding of multipath propagation in general and better characterization of the ATV transmission channel.

### *Background*

The greatest strength of COFDM is in its claimed capability of providing excellent performance in a multi path environment and its ruggedness to different types of interference. While these claims can be investigated and/or verified in the laboratory, most European investigators believe that field testing is an essential part of investigating the multipath performance of COFDM. This belief is further reinforced by the need to carefully engineer these new digital systems within the existing bands since the overall spectrum availability for digital television in Europe is much more limited and far more complex than in the United States. Moreover, their desire to offer indoor and mobile reception and to implement national Single Frequency Networks (SFNs) demand more extensive field investigations than may be needed in the United States.

For the past two years or so, a number of OFDM/COFDM field measurement programs were conducting through Europe. These measurement programs ranged from a cursory look-and-see to a more comprehensive evaluation of OFDM/COFDM under real-world multipath conditions. Below is a brief description of some of these measurement programs.

### *Status*

#### HD-DIVINE

Since the demonstration of an initial prototype in June 1992 at IBC, HD-Divine has been demonstrating their system (version 1.0) at various trade shows throughout Europe. The version 1.0 equipment was installed on two mobile trailers capable of transmitting and receiving the COFDM signal at very close distances (a few feet to a 1.2 mile away).

Limited field trials were conducted in the city of Stockholm using the version 1.0 hardware. The field tests were conducted using an existing UHF-PAL transmitting facility ( approximately 1000 feet above ground) and operating at 44 dB below its rated analog transmitted power. Using a receiving installation at the standard 30 feet above ground, measurements and subjective observations were carried out at different locations within a 10 km radius from the transmitter. The HD-Divine decoder did not incorporate forward error correction. Even though the decoder did not include forward error correction, good reception was achieved within a 10 km radius of the transmitter.

HD-Divine plans to conduct more extensive field testing with their new hardware (version 2.0) in the 1995 time frame.

#### CCETT

The CCETT prototype hardware was originally demonstrated at the Montreux International Television Symposium in June 1993. The prototype hardware used at the Montreux Symposium was not the same as the one shown to the Task Force at Rennes, but the earlier version (448 carriers and 16 QAM). The Montreux demonstration used a transmitting facility located approximately 10 miles from the receiving installation. The receiving installation was located on the second level of a four-story building. An indoor vertical whip antenna was used to receive the COFDM signal.

No other field test measurement programs were reported by CCETT, however plans are underway to conduct extensive field tests in the 1994 time frame.

## Thomson CSF LER

The Thomson prototype hardware was originally demonstrated in June' 1993 at Montreux. The Montreux demonstration used a dual polarization transmission/reception configuration and transmitted one HDTV and four SDTV channel on the same 8 MHz channel. The transmitting facility was located approximately 1/2 mile from the receiving installation.

Since the Montreux demonstration, Thomson in collaboration with BBC conducted a moderately large field test experiment in the United Kingdom. Specifically, the prototype was used to test the robustness of OFDM in the field in the presence of low-level and strong echoes or PAL interference. Approximately 60 receiving locations in and around the transmitting facility and as far out as 25 km from the transmitter were surveyed. BER data and other observations were recorded on both polarizations. The measurements were conducted at 30 feet above ground using two separate highly directional antennas. Except for a limited number of locations where the cross-polarizations discrimination was 3 dB or less, dual reception was achieved using separate antennas. A graph of field strength versus bit error rate is shown in Figure 3 of with this report.. The hardware used for this measurement program did not include an efficient error-correction mechanism or suitable guard band (less than 8 microseconds) to deal with strong and/or large delays echoes.

Thomson plans to conduct more extensive tests in the 1994-1995 time frame.

## NLT / ITC

By far the most extensive field measurements conducted to date in Europe was undertaken by NLT/ITC. Since its inception, the SPECTRE investigators have and are expected to rely heavily on field observations to assist them in the design and optimization of their channel coder/decoder. Specifically, the SPECTRE project conducted a number of large-scale field experiments using OFDM transmission and a number of different modulation schemes (QPSK, 8PSK and 16 QAM) over an 18 month period. The experiments were generally undertaken to collect propagation data and catalog different multipath conditions so as to better characterize and/or model the transmission channel. Most of the field measurements were conducted in the southwestern part of England.

While most of the experimental data is currently being analyzed and has not been released, NLT/ITC reported extensively on one of its field measurement

programs intended to collect bit error rate measurements over a wide geographical area. Approximately 300 receiving locations within a 30 mile radius of an OFDM transmitter located at Stockland Hill were measured along with measurements relating to interference from and to existing co-channel and adjacent channel PAL transmitters. In addition, information was collected on the effect of ignition and impulse noise on an OFDM signal in the field. A standard 30 foot receiving installation was used for this experiment.

In addition to the field measurement program underway, NTL has also conducted two live demonstrations within the United Kingdom in 1992. The first demonstration was held at Exeter in South-West England and the second in London. The system used QPSK modulation of an OFDM signal at an ERP of 50 Watts. The net video data rate was 10 Mbit/s.

NTL plans for additional and more extensive field measurements in 1994.

## **Recommendation**

During our visits, subsequent discussions, the questions and answers that preceded the visits, and the preparation of this report, we have considered COFDM very seriously. We offer no clear-cut and obvious recommendation. We believe that COFDM technology is a potential modulation technique for North American ATV, but that it will require considerable additional development. We have determined that no COFDM hardware to North American specifications exists in a state ready for testing, and we have learned that there are no plans to create such hardware in Europe. We have identified two important "gating" decisions that should precede any effort to create a COFDM system for North America:

- 1) Before undertaking the development of a COFDM system for North America, we should determine that COFDM's claimed strong tolerance of multiple ghosts is a compelling advantage for terrestrial broadcast in North America; we must also establish that the somewhat lesser ability of QAM and VSB systems with multiple ghosts represents an important practical handicap in terrestrial broadcast. We must recognize that no solution for handling multipath associated with mobile reception exists for COFDM at ATV data rates.

- 2) Before ACATS embarks on a development program, it must recognize that development of a COFDM system for North America will delay the ATV process; ACATS must determine that delay is acceptable. A COFDM system requires inventions to create practical receiver

circuits, signal acquisition times, synchronization, and carrier recovery. The system parameters must also be defined by experiment.

The people with whom we met on this trip were not appropriate for discussions of licensing policies, nor were the members of our delegation. A separate discussion of licensing policy should be undertaken. We believe that we must obtain the promise of a non-discriminatory policy with "fair and reasonable" rates.

We recommend that we continue to monitor COFDM developments world-wide. If the Advisory Committee considers the matter important, this Task Force would undertake the paper design of a COFDM system for North America; we would consult with our colleagues in Europe and Japan in the process. The contacts we have made on this trip have all indicated they would be happy to share their experiences to help us with such an undertaking.

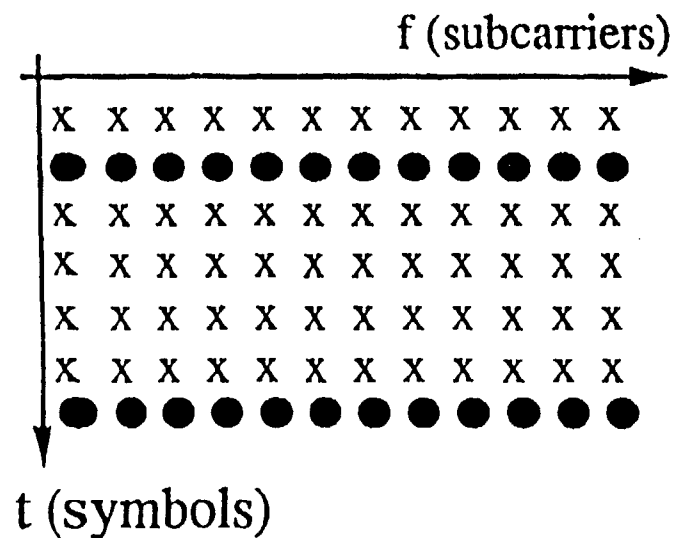
	DIVINE 1.0	DIVINE 2.0	LER	CCETT Prototype	NTL	DIVINE Strawman	CCETT Strawman
FFT Size (Points)	1024			1024	1024	8192	2048
Number of Active Carriers	448	<= 13 K (?)	481	840/896	432	5500	1388/1408
Carrier Spacing (kHz)	15.625					1	
Bandwidth (MHz)	7.76/8.0	flexible	7.07	7	7.47	5.5	5.5
Omitted Carriers: PAL Luma			35				
Omitted Carriers: PAL Chroma			12				
Omitted Carriers: PAL Sound			18				
Modulation per Carrier	16 QAM	4-256 QAM	256 QAM	64 QAM	QPSK/8PSK 16 QAM	64 QAM	64 QAM
Gross Bit Rate w/FEC Overhead (Mb/s)	27.017			20.58	13.5 (QPSK)		19.096
Net Usable Bit Rate (Mb/s)	25.088	<= 35	34.01/29.7			19.03	
Total Symbol Duration (us)	65.95/64.0			160		1032	288
Length of Guard Interval (us)	0/1.95	20 or more	8.8	32	0/2	32	32
Active Symbol Duration (us)	64		70.4	128	64		256
Transmission Frame Time (ms)				24		43.344	72
Total OFDM Symbols/Frame	512						250
Number of Sync Symbols/Frame	3	<= 3		3		2 Test + 40 Data	2 + 1/64 of Carriers
Channel Equalization Overhead			1/15 symbols				
Active OFDM Symbols/Frame	509	flexible					248
Eb/No @ 10 <sup>-6</sup> (-6) (Gauss Channel)						8.3 dB	
C/N Threshold (dB)		18	22-23				
Inner Code		Trellis	Trellis	Trellis		Trellis	Trellis
Inner Interleaving						Frequency	
Outer Code	RS(224,208)	RS	RS		RS(255,239)	RS(255,239)	
Outer Interleaving						Time	
Carrier Acquisition Range (kHz)	+/- 10-20		12 (+/- 6 ?)				

**Table 1 - Summary of OFDM Systems**

# COFDM FOR DIGITAL TERRESTRIAL BROADCASTING NETWORKS

## CHANNEL ESTIMATION

time interpolation:  
reference symbols



frequency interpolation:  
pilot subcarriers

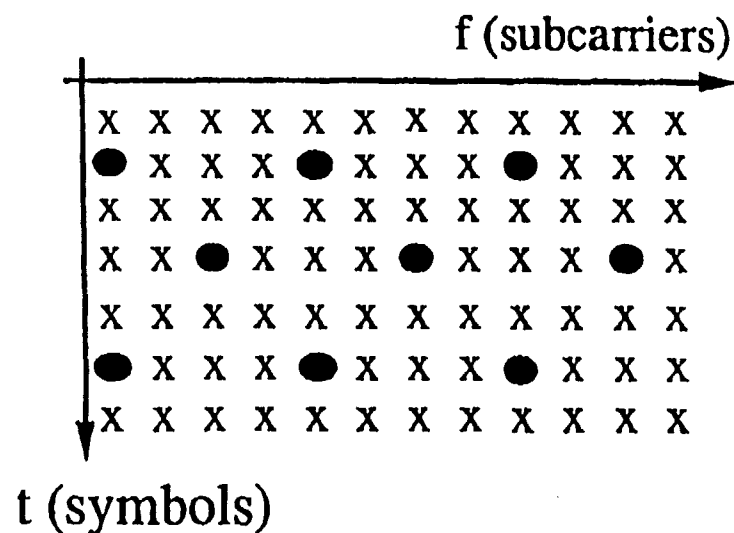


Figure 1

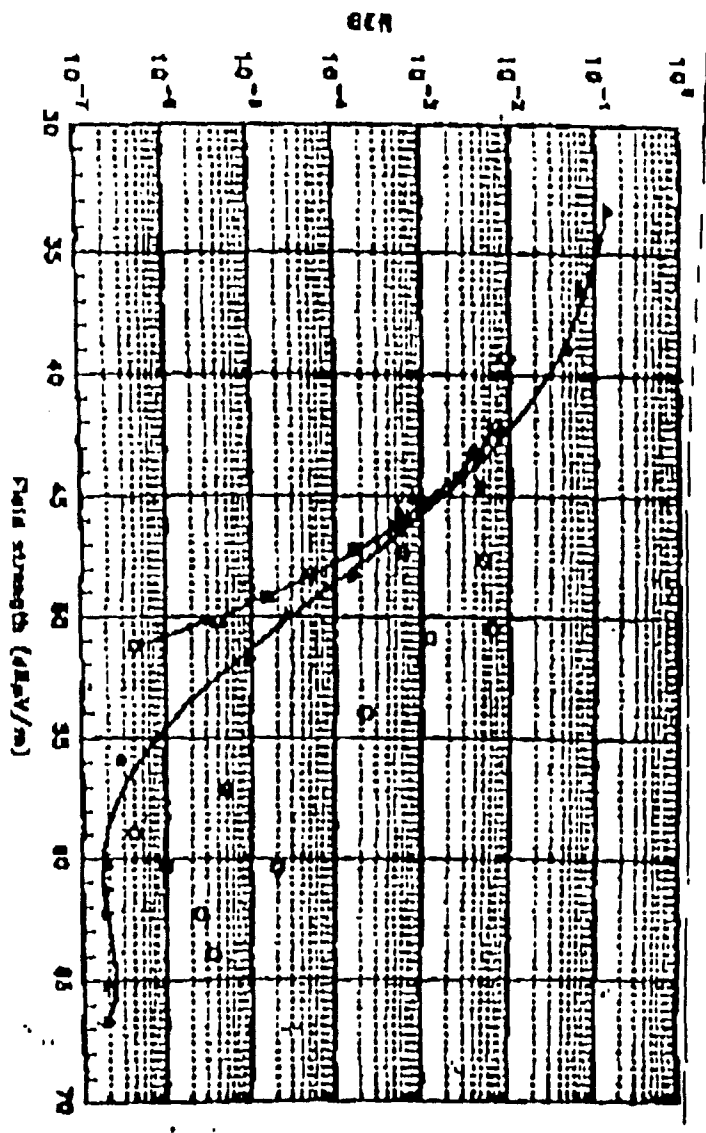
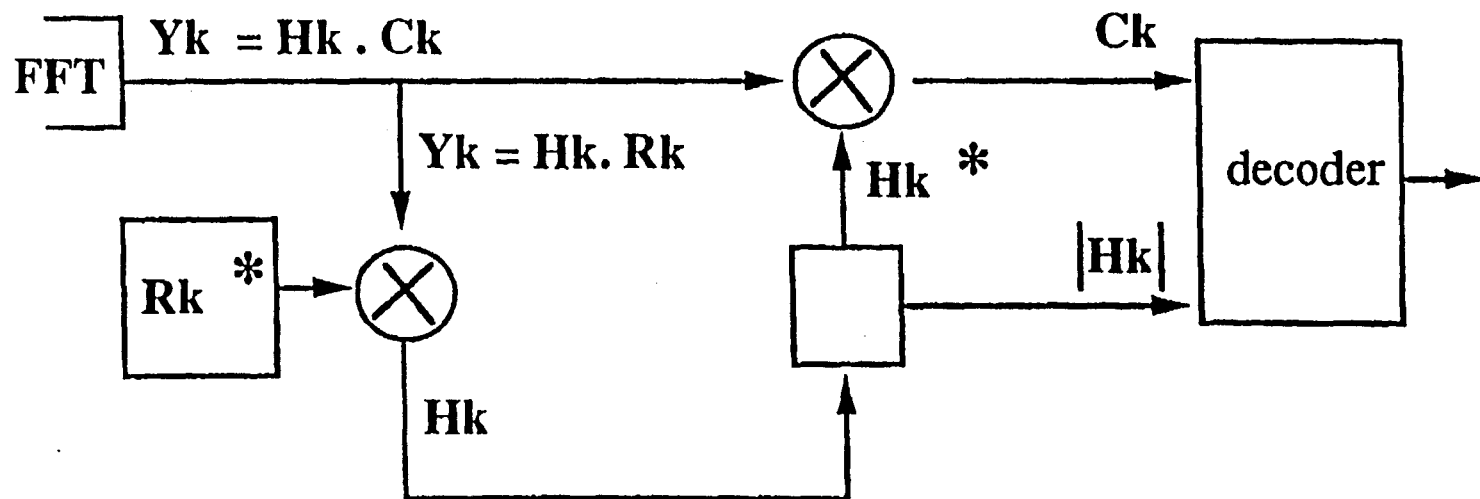


Figure 3



# COFDM FOR DIGITAL TERRESTRIAL BROADCASTING NETWORKS

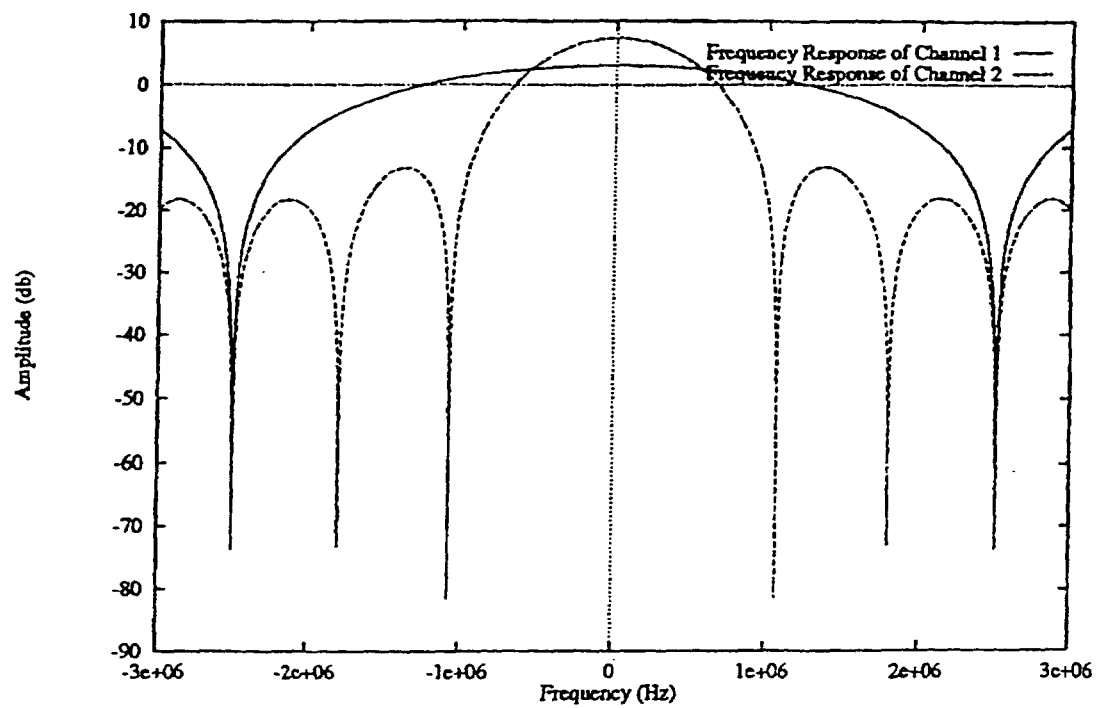
## COHERENT DEMODULATION



## APPENDIX:

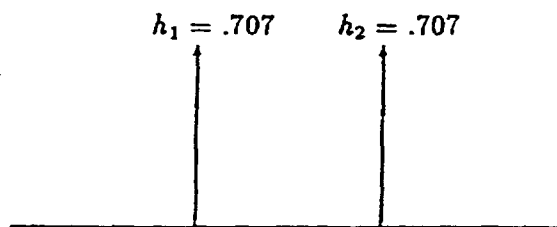
While COFDM exhibits performance enhancement in some multipath channels, it should be noted that it is not possible to extrapolate the results from a few examples to all cases. CCETT mentions that the "worst case" channel is a 2-ray multipath with a 0 dB echo and that adding echoes will improve C/N without any performance degradation. This claim cannot be theoretically proven and in fact it can be shown in many cases that the addition of extra echoes causes a greater loss in performance. For example, Figure 1 shows the impulse responses of 2 channels: Channel 1 is a single echo channel with a 0 dB echo and Channel 2 is the impulse response of a channel with a 0 dB echo and additional echoes. In both cases the echoes are spaced equidistant from each other. Figure 2 shows the frequency response of these two channels and it is clear that Channel 2 exhibits more nulls and will have a worse performance in terms of BER than Channel 1, even though both channels have been normalized to have the same energy. In fact, if the echo spacing is equal to the symbol rate, for Channel 2 the loss with optimal maximum likelihood sequence estimation is of the order of 7 dB (see Digital Communications by Proakis, page 624) while for Channel 1 the theoretical loss is very close to zero. While this comparison is based on an optimal receiver and other ideal conditions, it does show that it is misleading at best to say that the single 0 dB echo channel is the "worst case" channel.

Another point to note is that the performance of COFDM in multipath depends very heavily on the coding and hence a much lower code rate ( $2/3$  as opposed to  $4/5$  for single-carrier systems) and more complex coding is required.

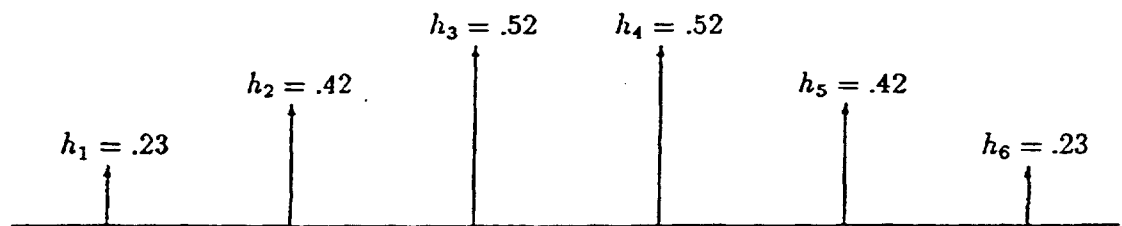


Frequency responses of Channel 1 and Channel 2

Figure A-1



(a) Impulse response of Channel 1.



(b) Impulse response of Channel 2.

Impulse response of two multipath channels

**Figure A-2**



11 August 1999

# **Digital Television Equipment and Services**

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*Available from **ATSC** Member Companies*

**Advanced Television Systems Committee  
1750 K Street NW  
Suite 1200  
Washington, DC 20006  
+ 1 202 828 3130  
+ 1 202 828 3131 (fax)**

## **NOTE**

**This list of products and services is intended to be useful to readers planning to deploy ATSC digital television systems. Some products listed may comply with the ATSC Digital Television Standard or with related ATSC standards, while others provide functionality which does not require such compliance. Readers should contact the manufacturers and service providers for further information.**

**The Advanced Television Systems Committee makes no representations or warranties concerning the performance or appropriateness of any of the listed equipment or services, or the status of their compliance with applicable standards. ATSC Members who wish to contribute to this directory should contact Lori Gildow at [lgildow@mindspring.com](mailto:lgildow@mindspring.com).**

**This list is not necessarily a comprehensive list of equipment and services available from ATSC member companies.**

**This list will be updated regularly, and is available for download at no charge to any interested party from the ATSC web site at [www.atsc.org](http://www.atsc.org).**

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# ACRODYNE

[www.acrodyne.com](http://www.acrodyne.com)

Product	Model No.	Availability
100kW Diacode UHF DTV Transmitter	AuD-100D	Currently Available
75kW Diacode UHF DTV Transmitter	AuD-75D	Currently Available
50kW Diacode UHF DTV Transmitter	AuD-50D	Currently Available
25kW Diacode UHF DTV Transmitter	AuD-25DD	Currently Available
25kW Diacode UHF DTV Transmitter	AuD-25D	Currently Available
4kW Diacode UHF DTV Transmitter	AuD-4D	Currently Available
500W Solid State UHF DTV Transmitter	AuD-500	Currently Available
250W Solid State UHF DTV Transmitter	AuD-250	Currently Available
4kW Solid State UHF DTV Transmitter	AuD-4S	Currently Available
2kW Solid State UHF DTV Transmitter	AuD-2S	Currently Available
1kW Solid State UHF DTV Transmitter	AuD-1S	Currently Available
12kW Tetrode UHF DTV Transmitter	AuD-12T	Currently Available
6kW Tetrode UHF DTV Transmitter	AuD-6T	Currently Available
4kW Tetrode UHF DTV Transmitter	AuD-4T	Currently Available
2kW Tetrode UHF DTV Transmitter	AuD-2T	Currently Available
500W Solid State VHF DTV Transmitter	TRH-DTV/500	Currently Available
300W Solid State VHF DTV Transmitter	TRL-DTV/300	Currently Available
250W Solid State VHF DTV Transmitter	TRH-DTV/250	Currently Available
4kW Solid State VHF DTV Transmitter	TRH-DTV/4K	Currently Available
2kW Solid State VHF DTV Transmitter	TRH-DTV/2K	Currently Available
1kW Solid State VHF DTV Transmitter	TRH-DTV/1K	Currently Available
12kW Tetrode VHF DTV Transmitter	TRH-DTV/12KA	Currently Available
8kW Tetrode VHF DTV Transmitter	TRL-DTV/8KA	Currently Available
8kW Tetrode VHF DTV Transmitter	TRH-DTV/8KA	Currently Available
4kW Tetrode VHF DTV Transmitter	TRL-DTV/4KA	Currently Available
4kW Tetrode VHF DTV Transmitter	TRH-DTV/4KA	Currently Available
2kW Tetrode VHF DTV Transmitter	TRL-DTV/2KA	Currently Available
2kW Tetrode VHF DTV Transmitter	TRH-DTV/2KA	Currently Available

**Tom Newman, National Sales Manager**

516 Township Line Road  
Blue Bell PA 19422 USA

+ 1 215 542 7000 or 800-523-2596

+ 1 215 540 5837 fax

Email: [tom.newman@acrodyne.com](mailto:tom.newman@acrodyne.com) or [acroinfo@acrodyne.com](mailto:acroinfo@acrodyne.com)

ATSC DTV Equipment and Services

11 August 99

# ADC Telecommunications

[www.adc.com/broadcast](http://www.adc.com/broadcast)

Product	Model No.	Availability
8 VSB Modulator	DT1A	<i>Currently Available</i>
Digital UHF Exciter / Modulator	DT20A	<i>Currently Available</i>

Product	Model No.	Availability
150 W UHF Solid State Transmitter	DT825A	<i>Currently Available</i>
325 W UHF Solid State Transmitter	DT830A	<i>Currently Available</i>
650 W UHF Solid State Transmitter	DT834A	<i>Currently Available</i>
1300W UHF Solid State Transmitter	DT835A-4	<i>Currently Available</i>
1650W UHF Solid State Transmitter	DT835A-5	<i>Currently Available</i>
2000W UHF Solid State Transmitter	DT835A-6	<i>Currently Available</i>
5 KW UHF Diacode Transmitter	DT840A	<i>Currently Available</i>
12.5 KW UHF IOT Transmitter (air-cooled)	Visionary DT / HP12SD	<i>Currently Available</i>
12.5 KW UHF IOT Transmitter (water-cooled)	Visionary DT/ HP12SDW	<i>Currently Available</i>
17.5 KW UHF IOT Transmitter	Visionary DT/ HP17SDW	<i>Currently Available</i>
25 KW UHF IOT Transmitter	Visionary DT/ HP25SDW	<i>Currently Available</i>
35 KW UHF IOT Transmitter	Visionary DT/ HP35DDW	<i>Currently Available</i>
50 KW UHF IOT Transmitter	Visionary DT/ HP50DDW	<i>Currently Available</i>
75 KW UHF IOT Transmitter	Visionary DT/ HP75TDW	<i>Currently Available</i>
100 KW UHF IOT Transmitter	Visionary DT/ HP100QDW	<i>Currently Available</i>

**Rich Dell**  
102 Rahway Road  
McMurray PA 15317-3349 USA  
+ 1 724 941 1500 ext. 129  
+ 1 724 941 4603 fax  
Email: [rich\\_dell@adc.com](mailto:rich_dell@adc.com)

## Adherent Systems Ltd.

[www.adherent.com](http://www.adherent.com)

Product	Model No.	Availability
ATSC/DVB recorder, player, real time analysis with multiplexer	AD 953-II Stream Station II	Currently Available
Combined ATSC/DVB record, play and multiplex tool	AD 951-II Stream Player II	Currently Available
Combined ATSC/DVB offline analysis tool	AD 950 Stream Analysis	Currently Available
ATSC broadcast monitoring tool w/ A/53 & PSIP monitoring	AT 970 ATSC Stream View	Currently Available
ATSC/DVB looping seamless signal source	AD 991 Stream Source	Available 2 <sup>nd</sup> qtr '99

**Graham Norgett**  
Endeavour House, Vision Park  
Histon  
Cambridge CB4 4ZR United Kingdom  
+ 44 01223 200700  
+ 44 01223 200701 fax  
Email: [gwn@adherent.com](mailto:gwn@adherent.com)

## Advent Television

[www.advent.com.sg](http://www.advent.com.sg)

Digistics™ is a business unit of Advent Television, it is the international design and installation arm, which distributes the expertise gained and intellectual property developed during the building and commissioning of the world's first digital broadcast facility in Singapore this year. Digistics™ provides broadcasters with guaranteed, turnkey, technical & business solutions to the digital broadcasting opportunities. Digistics™ makes the transition to digital worry free.

**Peter Burrows**  
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510 Thomson Road  
#12-04 SLF Building  
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+65 252 2077  
+65 252 5158 fax  
Email: [peter@advent.com.sg](mailto:peter@advent.com.sg)

## BARCO, Inc.

[www.barco.com](http://www.barco.com)

Product	Model No.	Availability
MPEG-2 SDTV Encoder	RE4220 Encoder	<i>Currently Available</i>
MPEG-2 SDTV Decoder	RE4220 Decoder	<i>Currently Available</i>
MPEG-2 HDTV Encoder	RE4220 HDTV Encoder	<i>Currently Available</i>
MPEG-2 HDTV Professional Decoder	RE4220 HDTV Decoder	<i>Available 1st qtr '99</i>
MPEG-2 Integrated Receiver Decoder	RE4220 IRD	<i>Available 1st qtr '99</i>
MPEG-2 HDTV Integrated Receiver Decoder	RE4220 HDTV IRD	<i>Available 1st qtr '99</i>
High Definition Monitor (19" Rack Mount)	HDM-5049	<i>Currently Available</i>

**James Durant**

3240 Town Point Drive  
Kennesaw GA 30144 USA

+ 1 770 218 3200

+ 1 770 218 3250 fax

Email: [james.durant@barco.com](mailto:james.durant@barco.com)

## CED / Electric & Electronic Products Development Association

CED's member companies provide a variety of equipment types useful for DTV deployment. Contact CED for details.

**Mr. C K Chuang**

9F-9, No. 14, Lane 609  
Chunghsin Road, Sec. 5 Sanchung  
Taipeihsien, Taiwan R.O.C

+2 2 999 3600 ext. 106

+2 2 999 3496 fax

Email: [standard@ced.org.tw](mailto:standard@ced.org.tw)

## Cinesite Digital Studios

[www.cinesite.com](http://www.cinesite.com)

Cinesite Digital Studios, a subsidiary of Eastman Kodak (see separate listing), provides postproduction services for visual and special effects.

**Al DiNoble**

1017 North Las Palmas  
Hollywood CA 90038 USA  
+ 1 213 468 4400  
+ 1 213 468 2136 fax  
Email: [dinoble@cinesite.com](mailto:dinoble@cinesite.com)

## Continental Electronics

[www.contelec.com](http://www.contelec.com)

Product	Model No.	Availability
ATSC 8-VSB Exciter	701D	Available 1st qtr '99
Solid State UHF Transmitter	714D	Currently Available
Solid State VHF High Band Transmitter	n/a	Available 1st qtr '99
IOT UHF Transmitter	n/a	Available 1st qtr '99

Continental Electronics provides system engineering and integration services.

**Dan Dickey**

PO Box 270879  
4212 South Buckner Blvd  
Dallas TX 75227 USA  
+ 1 214 381 7161  
+ 1 214 381 4949 fax  
Email: [dlDickey@contelec.com](mailto:dlDickey@contelec.com)

## Convergence Services, Inc.

[www.dtvbusiness.com](http://www.dtvbusiness.com)

Convergence Services, Inc. provides consulting, government relations, regulatory monitoring, and business development services for digital television implementation. The company's DTV experience dates to 1993, and its clients have included PBS, Westinghouse, and individual television stations. CSI currently represents a consortium of 27 public television stations in the largest US markets. CSI is also a producer of satellite-delivered training, including an October 1998 videoconference, "Digital Television Business Opportunities: Creating a New Industry."

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+ 1 703 548 0726 fax  
Email: [jlawson@convg.com](mailto:jlawson@convg.com)

## Digital Broadcasting OVS

[www.dbovs.com](http://www.dbovs.com)

Product	Model No.	Availability
HDTV	n/a	Available 4 <sup>th</sup> qtr '98 (LA /San Diego)
ATM DTV - HDTV	n/a	Available 4 <sup>th</sup> qtr '98 (LA /San Diego)
ATM Education on-Demand	n/a	Available 1 <sup>st</sup> qtr '99 (LA /San Diego)
ATM DTV	n/a	Available 2 <sup>nd</sup> qtr '99 (LA /San Diego)

**Roy Jimenez**  
520 W. Santa Ana Blvd.  
Santa Ana CA 92701 USA  
+ 1 714 564 0888  
+ 1 714 564 0900 fax  
Email: [hdone@earthlink.net](mailto:hdone@earthlink.net)

## Digital Vision DV Sweden AB

[www.digitalvision.se](http://www.digitalvision.se)

[www.digitalvision.se/dvm19.htm/](http://www.digitalvision.se/dvm19.htm/)

Product	Model No.	Availability
BitLink-HD HDTV Program Encoder	DVM19E-HD/10	Currently Available
BitLink-HD HDTV Program Decoder	DVM19D-HD/10	Currently Available
HiDef Adaptive Grain & Noise Reducer	HDNR1001	Currently Available
HiDef Adaptive Scratch Concealer-II	HDNR1002	Currently Available
HiDef Adaptive Primary and Secondary Color Processor	HDCC1002	Currently Available
HiDef Advanced Aperture Corrector	HDAC1001	Currently Available
BitPack-HDTV Video and Audio Encoding System	BitPack-HD	Available Apr '99

**Peter Weiss**

Upplagsv 1

SE-117 43 Stockholm Sweden

+ 46 8 18 24 65

+ 46 8 182466 fax

Email: [peterw@digitalvision.se](mailto:peterw@digitalvision.se)

## DiviCom

[www.divi.com](http://www.divi.com)

Product	Model No.	Availability
MPEG-2 Encoder	MV-10	Currently Available
MPEG-2 Encoder	MV-40	Currently Available
MPEG-2 Multiplexer	MN-20	Currently Available
System Controller	SC-TW-17	Currently Available
Data Carousel/PSI Injector	MMT	Currently Available
Professional IRD	TT-1100	Currently Available

DiviCom provides system integration internationally with the ATSC compliant products listed above.

**Bill Nicholls**

1708 McCarthy Blvd.

Milpitas CA 95035 USA

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+ 1 408 490 6647 fax

Email: [nicholls@divi.com](mailto:nicholls@divi.com)

ATSC DTV Equipment and Services

11 August 99



## Dolby Laboratories, Inc.

[www.dolby.com](http://www.dolby.com)

Product	Model No.	Availability
Dolby Surround Encoder	SEU4	Currently Available
Dolby Surround Decoder	SDU4	Currently Available
Dolby Digital Reference Decoder	DP562	Currently Available
Dolby Digital Two-channel Encoder	DP567	Currently Available
Dolby Digital Reference Encoder (up to 5.1 ch)	DP569	Currently Available
Dolby E Encoder	DP571	Available Summer '99
Dolby E Decoder	DP572	Available Summer '99

### Dolby Laboratories, Inc.

100 Potrero Avenue  
San Francisco CA 94103-4913 USA  
+ 1 415 558 0200  
+ 1 415 863 1373  
Email: [info@dolby.com](mailto:info@dolby.com)

Wootton Bassett  
Wiltshire SN4 8QJ England  
+ 44 1793 842 100  
+ 44 1793 842 101 fax

## Eastman Kodak Company

[www.kodak.com/go/motion](http://www.kodak.com/go/motion)

Product	Model No.	Availability
Color Negative Camera Films	VISION	Currently Available
Color Negative Camera Films	EXR	Currently Available
Color Negative Camera Films	PRIMETIME	Currently Available
Color Reversal Camera Films	EKTACHROME	Currently Available

### Randy Sparrazza

Sales Development Coordinator  
Television Segment  
343 State Street  
Rochester NY 14650-0315 USA  
+ 1 716 781 7754  
+ 1 716 724 9702 fax  
Email: [sparrazz@kodak.com](mailto:sparrazz@kodak.com)

## EIDEN Co., Ltd.

[www.eiden.com](http://www.eiden.com)

Product	Model No.	Availability
8/16 VSB Modulator	3311A-002	Currently Available
All Channel Upconverter	4211A	Currently Available
BER Adapter	2713A-B01	Currently Available
TS Sync Inserter	2703D	Currently Available
Television Ghost Signal Generator	451D-A	Currently Available
TS Signal Generator	2708A-001	Currently Available

**M. Satomura**

1026 Kuriki, Asao-KU

Kawasakishi, Kanagawa 215 JAPAN

+ 81 44 988 4111

+ 81 44 987 7058 fax

Email: [satomura@eiden-gp.co.jp](mailto:satomura@eiden-gp.co.jp)

## EQUATOR Technologies

[www.equator.com](http://www.equator.com)

Product	Model No.	Availability
ATSC Media Processor IC	MAP100	Available Jan '99
Jamaica set-top box	Reference	Currently Available

**Ted Niday**

1300 White Oaks Road

Campbell CA 95008 USA

+ 1 408 369 5428

+ 1 408 371 9106 fax

Email: [niday@equator.com](mailto:niday@equator.com)

## FAROUDJA Laboratories

[www.faroudja.com](http://www.faroudja.com)

Product	Model No.	Availability
Digital Format Translator: ITU-R601 > HD-SDI 1080i w/preset aspect ratios	DFT-3	Currently Available
Digital Format Translator: ITU-R601 > 1080i w/SCS Software Advanced Video Enhancement and variable aspect ratio control	DFT-3S	Currently Available
Digital Format Translator: Multiple 525 formats in > 480p, 720p, 1080i w/SCS Software, Advanced Video Enhancement, variable aspect ratio control, and digital noise reduction	DFT-3A	Currently Available

**Glen Sakata**  
750 Palomar Avenue  
Sunnyvale CA 94086 USA  
+ 1 408 735 1492  
+ 1 408 735 8571 fax  
Email: [gsakata@faroudja.com](mailto:gsakata@faroudja.com)

## General Instrument Corp.

[www.gi.com](http://www.gi.com)

Product	Model No.	Availability
Multi-channel SDTV Encoder	DCII-SD	Currently Available
Single-channel SDTV Encoder	DCII-SCE	Currently Available
Single-channel HDTV Encoder	DCII-HD	Available Sept '98

**Martin Stein**  
6262 Lusk Blvd.  
San Diego CA 92121 USA  
+ 1 619 404 2933  
+ 1 619 525 2485 fax  
Email: [mstein@gi.com](mailto:mstein@gi.com)

# Global Broadcasting Corporation

[www.global-bc.com](http://www.global-bc.com)

**GBC's HDTV Services** provide digital HDTV contribution quality signal transport over wide area networks (WAN'S). These services can be arranged from anywhere to anywhere in the world via existing transmission networks of satellite, fiberoptic, radio and standard high-speed telephone lines on a point-to-point and multi-point basis.

**GBC's SuperTrunking™** service provides broadcasters with HDTV contribution and backhaul links between program origination site, broadcast center and the affiliated TV stations prior to converting to the ATSC standard for final distribution to the consumer. This service allows the local broadcaster to manage HDTV and the new ATSC Standard with local content and advertising insertion in the same way they manage SDTV today.

**GBC's FrontRow™** service provides it's customers with special closed circuit exhibitions and events on a turn key basis. The service uniquely provides large cinema sized screens and regular screen displays in cinema quality for both public and private audiences.

**Tim Phillips**  
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Plano TX 75025 USA  
+ 1 972 618 4524  
+ 1 972 618 0156 fax  
Email: [tdphillips@global-bc.com](mailto:tdphillips@global-bc.com)

## Global Corporation

Product	Model No.	Availability
HDTV Terrestrial Decoder	GSR-7000	Available Aug '99
HDTV Terrestrial & Satellite Decoder	GSR-9000	Available Aug '99

**#604 Dampoog Plaza 474**  
**DANG**  
5751 Copley Drive  
San Diego CA 92111 USA  
+ 1 858 587 0252  
+ 1 858 587 0257 fax  
Email: [kdunford@tiernan.com](mailto:kdunford@tiernan.com)

# Harris Corporation Broadcast Division

[www.broadcast.harris.com](http://www.broadcast.harris.com)

Product	Model No.	Availability
ATSC MPEG-2 Standard Definition Encoding System	FlexiCoder FLXC4SD	Currently Available
ATSC MPEG-2 Multi Standard Encoding System	FlexiCoder FLXC6SD1HD	Currently Available
ATSC MPEG-2 High Definition Encoding System	FlexiCoder FLXC1HD	Available Mar '99
ATSC Professional Receiver	ARX100	Currently Available

**Jay C. Adrick**  
7920 Kentucky Drive  
Florence KY 41042 USA  
+ 1 606 282 4800  
+ 1 606 283 2818 fax  
Email: [system@harris.com](mailto:system@harris.com)

Harris Corporation Broadcast Division provides DTV Transmitter Supervision/Installation globally and DTV Training and Seminars in the Quincy location.

**Dave May**  
3200 Wismann Lane  
Quincy IL 62301 USA  
+ 1 217 221 7647  
+ 1 217 222 9443 fax  
Email: [dmay@harris.com](mailto:dmay@harris.com)

Product	Model No.	Availability
VHF DTV Circular Polarized Antenna	CBR	Currently Available
VHF DTV Panel Antenna	Deltawing	Currently Available
VHF DTV Antenna	Batwing	Currently Available
UHF DTV Panel Antenna	Deltawing	Currently Available
UHF DTV Slot Antenna Single or Dual Channel	Wavestar	Currently Available

**Rex Niekamp**  
+ 1 217 221 7311  
+ 1 217 221 7088 fax  
Email: [rniekamp@harris.com](mailto:rniekamp@harris.com)

<b>Product</b>	<b>Model No.</b>	<b>Availability</b>
ATSC Rack Mount 5.1 Channel Audio Monitor	ATSC-1	<i>Currently Available</i>

**Dave Burns**

3712 National Road West  
Richmond IN 47374 USA  
+ 1 765 962 8596  
+ 1 765 962 0671 fax  
Email: [dburns02@harris.com](mailto:dburns02@harris.com)

<b>Product</b>	<b>Model No.</b>	<b>Availability</b>
UHF Solid State (LD MOS) DTV Transmitter 1.25-25 kW (Average Power)	<b>Diamond CD</b>	<i>Currently Available</i>
UHF (IOT) Transmitter 10-100 kW (Average Power)	<b>Sigma CD II</b>	<i>Currently Available</i>
VHF Solid State DTV Transmitter 1.25-25 kW (Average Power)	<b>Platinum CD</b>	<i>Currently Available</i>
8 VSB Modulator / Transmitter 1 Watt (Average Power)	<b>CD-1A</b>	<i>Currently Available</i>

**Tim Slate**

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